ROCK DENSITY

LAKEFIELD RESEARCH
A DIVISION OF FALCONBRIDGE LIMITED

PHONE (705) 652-3341
TELEX NO 06962842
FACSIMILE NO. (705) 652-6365

November 8, 1990

Mr. Rod MacLeod
Brohm Mining Corporation
P.O. Box 485
Deadwood, South Dakota
USA 57732

Dear Mr. MacLeod:

Re: Specific Gravity and Bulk Density Determinations

The specific gravity determinations in Lakefield Research's Project No. 3687, Progress Report No. 1 were conducted on pulverized material using an air comparison pycnometer (Bechman Model 930), which measures true volume and hence specific gravity. I have enclosed a few pages describing the unit and procedure.

The in-situ density of the samples was determined using a wax immersion procedure which determines the volume of the sample (length of core) including voids. I have enclosed a copy of our procedure.

Yours sincerely,
LAKEFIELD RESEARCH

K.W. S

K.W. Sarbutt
Manager - Mineral Processing

KWS:bjs
Enclosures - 2

185 CONCESSION STREET, POSTAL BAG 4300, LAKEFIELD, ONTARIO, CANADA K0L 2H0

Procedure ~~II~~ 4-6

LAKEFIELD RESEARCH OF CANADA LIMITED

STANDARD PROCEDURES

Definition: Bulk density of a sample is the weight of the sample divided by the volume of the sample including voids.

Procedure:

(1) Weigh each sample.

(2) Coat the sample with parawax heated in a container immersed in boiling water. N.B. Never heat parawax directly on a hot plate.

(3) Repeatedly immerse the sample in the parawax until completely sealed. Avoid heating the sample.

(4) Place the waxed sample in a measured volume of water and record the displaced volume.

(5) Weigh the waxed sample.

(6) Freeze the sample to remove the wax.

Calculations:

(1) Weight of wax = weight of sample + wax minus weight of sample.

(2) Volume of wax = weight of wax divided by S.G. (0.8913).

(3) Volume of sample = volume of sample + wax minus volume of wax.

(4) Bulk density (g/mL) = Weight of Sample divided by Volume of sample.

Example:

Sample No.	Wt. of Sample g	Wt. of Sample + Wax, g	Wt. of Wax g	S.G. of Wax	Vol. of Wax + Sample mL	Vol. of wax mL	Vol. of Sample mL	Bulk Densi[illegible] (g/mL
1	100.00	108.75	8.75	0.8913	54	9.82	44.18	2.26
2	158.53	171.51	12.98	↓	84	14.56	69.44	2.28
3	110.60	113.94	3.34		47	3.75	43.25	2.56
4	102.31	107.91	5.60		45	6.28	38.72	2.6[illegible]
5	117.81	123.98	6.17		61	6.92	54.08	2.1[illegible]
6	338.32	352.02	13.70		143	15.37	127.63	2.6[illegible]

1. INTRODUCTION

The Beckman Model 930 Air Comparison Pyconometer measures the volume of powdery, granular, porous and irregularly-shaped solids, rapidly and precisely. The manually-operated Pycnometer requires no power source, no wetting of the sample, and no gas pressure determinations. An accuracy exceeding 0.1 cc is readily attainable within a total analysis time of only a few minutes, and the two major limitations to accuracy (air leakage or heat transfer from, or to, the sample) are immediately apparent as pointer drift. Further, a purging facility is provided so that samples may be measured in appropriate gaseous atmospheres.

After a short period of instrument familiarization, the operator should be able to obtain volume measurements repeatable to better than ±0.05 cc. Two precision-ground steel balls supplied with the instrument provide a convenient standard for checking instrument accuracy. They also give the operator known volumes with which to learn the operation of the instrument, for which no special training is required. The instrument reads digitally in tenths of a cc for total volumes up to 50 cc.

A gas purging accessory, External Purge Manifold Attachment, is described in Section 9 and illustrated in Figure 4.

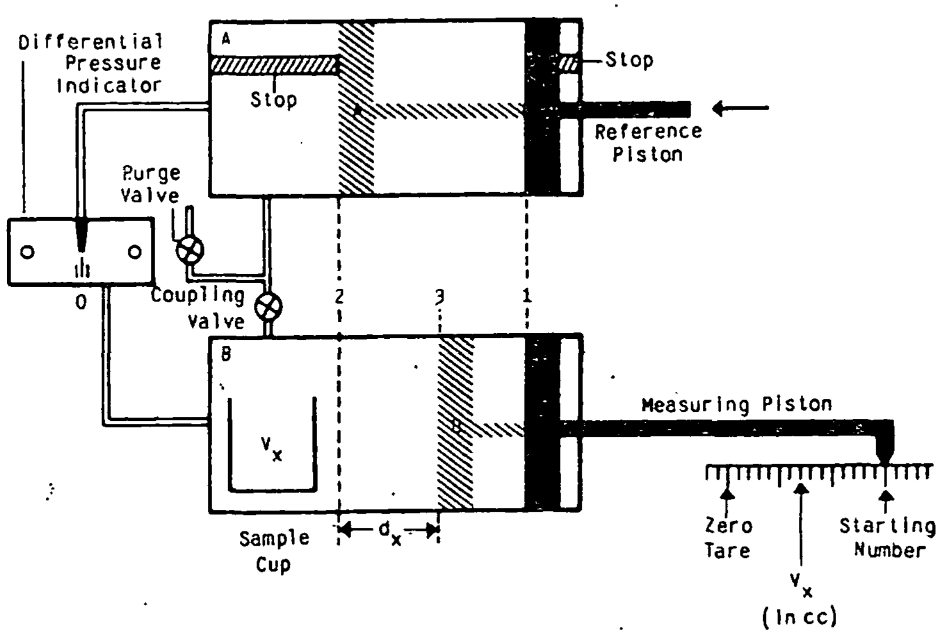
2. SPECIFICATIONS

Catalog Number:	93001 — Manually Operated
Starting Number:	Stamped on plate above Measuring Handwheel.
Size of Sample Container:	Approximately 50 cc volume (38.1 mm I.D. by 41.3 mm deep).
Accuracy:	Better than 0.1 cc. Experienced operator may obtain accuracies better than .05 cc.
Relative Humidity Range:	Less than 50%.
Ambient Temperature Range:	Between 15-35°C. (59-95°F)
Readout:	Digital counter provides direct readout from 0 to 50 cc in increments of 0.1 cc. The counter has 4 digits, reading in cc from left as follows: First three digits -- Whole Numbers Fourth digit -- In Tenths Graduated Scale -- In Hundredths
Corrosion Resistance:	Materials in contact with sample are aluminum, bronze, and neoprene.
Purge Facility:	Helium (or other gases) can be used to purge the instrument. Admit gas at 2 psig (13.8 kPa) or less.
Overall Dimensions:	6" X 9" X 10½" (152 mm X 228 mm X 266 mm). Made for desk use.
Weight:	14 pounds (6.35 kg).

3. PRINCIPLE OF OPERATION

There are two chambers and two pistons as sketched in Figure 1. For purposes of illustration, the chambers are assumed to be equal in volume, and there is no sample in either cylinder. With the connecting valve closed, any change in the position of one piston must be duplicated by an identical stroke in the other in order to maintain the same pressure on each side of the Differential Pressure Indicator. If the connecting valve is closed and both pistons are advanced the same amount to position 2 with a sample (V_X) inserted in chamber B, the pressures will not remain the same. However, the pressures in the two chambers can be made equal by withdrawing piston B from position 2 to position 3, an amount equivalent in volume to V_X. If piston A always is advanced exactly the same distance each time a measurement is made, the distance that piston B differs from position 2, when the pressures in both cylinders are equal, will always be proportional to the volume of V_X.

The distance between positions 2 and 3 (d_X) can be calibrated and made to read directly in terms of cubic centimeters. A digital counter is employed to indicate the distance d_X, so that the instrument can be read directly in cubic centimeters.



1. Simplified Schematic Diagram

4. APPLICATIONS

The true volume of a sample (the volume enclosed by its outer surface and excluding its open pores) is measurable by this instrument. From this volume the true density is calculated.

The apparent volume (the volume of a sample enclosed by its outer surface plus the volume of its open pores) is measurable by the Pycnometer if the pores first are filled. The pores are filled by immersing the sample in a molten wax bath until the bath and sample reach temperature equilibrium. The sample is removed from the bath and the droplets are shaken from the material. The wax-impregnated sample is cooled to ambient temperature prior to measurement with the Pycnometer. After the apparent volume has been measured apparent density is calculated.

Since both true and apparent volumes of the sample are measurable by the instrument, the open pore volume (the difference between true and apparent volumes) is readily determined. Open pore volume frequently is used as an index of porosity.

The specific gravity of a sample—which is the ratio of the sample density to water at 4°C — is readily computed, since the Pycnometer provides a rapid method for volume measurement. Sample weight is determined in the usual manner. Specific gravity serves as a useful criterion for substance classification and quantitative analysis.

4.1 MODES OF OPERATION

The Pycnometer is capable of several different modes of operation depending on the nature of the material to be measured. By the use of its volume measurement capability, the widest application of the instrument is in determination of densities and specific gravities. Measurements of volume also provide a useful index for establishing shrinkage during a chemical or physical change.

A general discussion of volume measurements and operational modes follows in this section. Stepwise procedure for the various modes of operation is given in Section 5.

The simplest operational mode uses room air as the gas and requires no pipe or tubing connections. Measurements are made by starting at initial pressures of one atmosphere and compressing the gas to two atmospheres. This method is suitable for the analysis of non-surface active, non-compressible materials. This procedure is given in Paragraph 5.2.

Compressible materials are best measured at atmospheric pressure. Paragraph 5.3.1 delineates this procedure. Expansion of the material at 1/2 atmosphere, which occurs during the operating cycle, introduces errors. The magnitude of such errors is a function of the shape and elasticity of the material. Empirical calibration curves can be made by comparing the Pycnometer results to accepted standards. When destructive testing is not objectionable and a grain volume (for grain density determinations) is desired, the sample should be reduced to particles smaller than any enclosed pores and measured in the usual 1 to 2 atmosphere method. In some cases, increased surface area may cause the material to be surface active.

Surface-active materials absorb some or all of the constituents of air. In extreme cases, such as highly surface-active materials, negative volumes may be obtained when using air and any of the operating procedures described above. Less active materials will usually give lower than true volumes.

The null indicator may be observed to be drifting for minutes after balance is believed to have been reached. (Drifting, however, may be due to other factors, as outlined in Trouble-Shooting, Section 6.) In general, if the Pycnometer drifts toward smaller indicated volumes with a sample but is stable with an empty cup or when using a calibration ball, the trouble is due to a surface-active material.

Many surface-active materials can be accurately measured by using helium in place of air. Other inert gases may be used although helium is more universally applicable.

As when air is used, the simplest purge operating procedure is the 1 to 2 atmosphere technique. This procedure is given in Paragraph 5.3.2. Some more highly surface-active materials exhibit adsorption characteristics at 2 atmospheres. In these cases, the 1 to 1/2 to 1 atmosphere purge operating technique in Paragraph 5.3.3 should be used.

Some highly active materials may, when using any of the above techniques, exhibit drift in either direction and give low or high volumes. Reasons for this behavior are not fully understood. In general, longer evacuation times or successive evacuation and inert gas fillings with the sample in place will allow measurement of these materials.

5. OPERATING PROCEDURE

5.1 GENERAL

The Model 930 Air Comparison Pycnometer (Figure 2) should be in approximate temperature equilibrium with its surroundings. Both sample and sample cup should be within 5°F (15°C) of instrument temperature; under these conditions, the zero measurement (on the counter) need be checked only before the first of several measurements in a given series. If the instrument is substantially above or below ambient temperature, maximum accuracy is achieved by taking a zero reading before each measurement, adding (or subtracting) the zero reading to (or from) the final reading. A calibration check may be made periodically. For detailed instructions on zero-measurement check and calibration check, see Paragraphs 5.4 and 5.5.

The most frequent source of non-repeatable results comes from failure to clamp and lock the sample cup FIRMLY in place in the sample compartment. A recommended standard procedure is to forcefully push down the sample holder handle (8, Figure 2) with the palm of the hand until the absolute stop has been reached.

If the Pycnometer has not been in use for several hours, an advisable procedure is to run both pistons in and out with their handwheels two or three times before measurements. When doing so, open the coupling

GILT EDGE BULK DENSITY ESTIMATES

1. <u>Sources of Data</u>

a) "Notes On the Northern Black Hills of South Dakota", Fraser, Transactions AIME, 1891:

Rock Type?? Tgtp or Ttp

Average specific gravity of porphyry from Hoodoo tunnel calculated at 171.94 lb/cu ft = 11.63 cu ft/ton. Presumably a dry density because rock above water level.

b) Dawson Metallurgical Laboratories, 8/28/85:

SG measurements on three samples give 2.58, 2.62, 2.58 (av. 2.59 = 12.87 cu ft/ton). Sample locations, rock types unknown. Not known whether SGs are wet or dry .

c) Twin City Testing, 5/8/87:

Wet density/SG measurements on 6 samples of sulfide and oxide ore and waste. No locations given. Two samples of rhyolite are ignored. Average bulk densities are:

Trachyte & breccia sulfide ore	- 12.89 cu ft/ton
Trachyte sulfide waste	- 12.97 cu ft/ton
Trachyte & breccia oxide ore	- 13.24 cu ft/ton
Trachyte oxide waste	- 13.75 cu ft/ton

Densities seem too low in comparison with other samples. However, they indicate that oxide material is about 4% lighter than sulfide, and that waste is about 2% lighter than ore (see attachment 1).

d) Bechtel, (date ?):

Total of 17 dry density measurements on 2,917 lbs 6" core from met test holes. Drillholes, depths, rock types listed. Give the following weighted dry density averages for major rock types (see attachment 2):

Trachyte porphyry/breccia	- 12.47 cu ft/ton
Deadwood fm/Precambrian	- 11.13 cu ft/ton
Quartz trachyte porphyry	- 11.44 cu ft/ton

All samples were taken from the sulfide ore zones.

2. Bulk Densities To Be Used In Tonnage Calculations

The weighted averages of the Bechtel results, rounded up to the nearest 0.1 cu ft/ton, are used for sulfide ore densities.

Oxide ore densities are determined by multiplying sulfide ore densities by 0.96 (based on Twin City Test results) and rounding up.

Any potential differences between ore and waste densities are assumed to be insignificant.

Density of "mixed" ore is assumed by convention to be half-way between oxide and sulfide density.

A table of the bulk densities to be used , in cu ft/ton, by ore type and rock type is given below:

Rock Type	Codes	Sulfide	Mixed	Oxide
Trachyte porphyry/ breccia	50, 60 70	12.5	12.8	13.1
Deadwood form/ Precambrian	10, 20 30, 40	11.2	11.4	11.7
Quartz trachyte porphyry	80, 85	11.5	11.7	12.0

ATTACHMENT 1

TWIN CITY TEST RESULTS

1. OXIDE DENSITIES VS. SULFIDE DENSITIES:

ROCK TYPE	SULFIDE DENSITY	OXIDE DENSITY	OXIDE/SULF (%)
Trachyte por. waste	2.47	2.33	94.3
Trachyte por. ore	2.53	2.45	96.8
Breccia ore	2.44	2.39	98.0
		Mean	96.4
		s.d.	1.9

2. ORE DENSITIES VS. WASTE DENSITIES:

ROCK TYPE	ORE DENSITY	WASTE DENSITY	WASTE/ORE (%)
Trachyte por. & breccia sulfide	2.49	2.47	99.2
Trachyte por. & breccia oxide	2.42	2.33	96.3
		Mean	97.8
		s.d.	2.1

ATTACHMENT 2

SUMMARY OF GILT EDGE DENSITY MEASUREMENTS

AVERAGE DENSITY TRACHYTE PORPHYRY: 12.47 CUFT/TON
AVERAGE DENSITY DEADWOOD & PRECAMBRIAN: 11.13 CUFT/TON
AVERAGE DENSITY QUARTZ TRACHYTE PORPHYRY: 11.44 CUFT/TON

ROCKTYPE	SAMPLE	LOCATION	TOP (FT)	FEET	WEIGHT	CUFT/TON	WTxDENS
Trporph	V1	D88-65	232	2.5	78	12.97	1005
	V2	D88-66	153.6	2.3	71	12.56	896
	V3	D88-67	158.4	3.0	93	12.66	1177
	V4	D88-67	240	2.7	84	12.66	1060
	V5	D88-67	463.3	2.6	81	12.51	1008
	V6	D88-69	584.3	2.5	78	12.46	966
	V7	D88-69	737.2	2.5	78	12.41	962
	V8	D88-69	887.5	2.5	78	12.76	989
	V9	D88-70	160.4	2.1	65	13.02	848
	V10	D88-72	1032.3	3.6	112	12.51	1396
	C1	D88-65	211.0	3.0	93	12.13	1128
		D88-66	185.6	2.8	87	12.13	1053
		D88-67	305.8	3.4	105	12.13	1279
		D88-68	582.7	2.8	87	12.13	1053
		D88-69	733.4	2.9	90	12.13	1090
		D88-70	156.5	2.7	84	12.13	1015
		D89-72	1008.7	3.3	102	12.13	1241
	C6	Ox Pit			580	12.61	7314
AVERAGE	12.47			SUMS	2043.20		25478.90
Ddwd/Pc	C4	D88-71	42.0	2.8	87	11.12	965
		D88-71	56.5	2.5	78	11.12	862
		D88-71	90.0	2.3	71	11.12	793
		D88-71	109.5	2.1	65	11.12	724
		D88-71	161.2	2.7	84	11.12	931
		D88-71	180.0	2.8	87	11.12	965
		D88-71	183.5	2.8	87	11.12	965
		D88-71	100.4	3.1	96	11.12	1069
	C5	D88-68	668.2	2.6	81	11.16	899
		D88-68	672.9	2.3	71	11.16	796
		D88-68	680.7	2.6	81	11.16	899
		D88-68	685.0	2.0	62	11.16	692
		D88-68	157.4	2.8	87	11.16	969
AVERAGE	11.13			SUMS	1035		11529
Qtrpor	C7	D88-68	802.2	2.6	81	11.44	922
		D88-69	644.5	2.5	78	11.44	887
		D88-69	648.0	2.5	78	11.44	887
		D88-68	782.0	13.5	419	11.44	4788
AVERAGE	11.44			SUMS	654		7483

GILT EDGE BULK DENSITY ESTIMATES

1. Sources of Data

a) "Notes On the Northern Black Hills of South Dakota", Fraser, Transactions AIME, 1891:

Average specific gravity of porphyry from Hoodoo tunnel calculated at 171.94 lb/cu ft = 11.63 cu ft/ton. Presumably a dry density because rock above water level.

b) Dawson Metallurgical Laboratories, 8/28/85:

SG measurements on three samples give 2.58, 2.62, 2.58 (av. 2.59 = 12.87 cu ft/ton). Sample locations, rock types unknown. Not known whether SGs are wet or dry .

c) Twin City Testing, 5/8/87:

Wet density/SG measurements on 6 samples of sulfide and oxide ore and waste. No locations given. Two samples of rhyolite are ignored. Average bulk densities are:

Trachyte & breccia sulfide ore	- 12.89 cu ft/ton
Trachyte sulfide waste	- 12.97 cu ft/ton
Trachyte & breccia oxide ore	- 13.24 cu ft/ton
Trachyte oxide waste	- 13.75 cu ft/ton

Densities seem too low in comparison with other samples. However, they indicate that oxide material is about 4% lighter than sulfide, and that waste is about 2% lighter than ore (see attachment 1).

d) Bechtel, (date ?):

Total of 17 dry density measurements on 2,917 lbs 6" core from met test holes. Drillholes, depths, rock types listed. Give the following weighted dry density averages for major rock types (see attachment 2):

Trachyte porphyry/breccia	- 12.47 cu ft/ton
Deadwood fm/Precambrian	- 11.13 cu ft/ton
Quartz trachyte porphyry	- 11.44 cu ft/ton

All samples were taken from the sulfide ore zones.

2. Bulk Densities To Be Used In Tonnage Calculations

The weighted averages of the Bechtel results, rounded up to the nearest 0.1 cu ft/ton, are used for sulfide ore densities.

Oxide ore densities are determined by multiplying sulfide ore densities by 0.96 (based on Twin City Test results) and rounding up.

Any potential differences between ore and waste densities are assumed to be insignificant.

Density of "mixed" ore is assumed by convention to be half-way between oxide and sulfide density.

A table of the bulk densities to be used , in cu ft/ton, by ore type and rock type is given below:

Rock Type	Codes	Sulfide	Mixed	Oxide
Trachyte porphyry/ breccia	50, 60 70	12.5	12.8	13.1
Deadwood form/ Precambrian	10, 20 30, 40	11.2	11.4	11.7
Quartz trachyte porphyry	80, 85	11.5	11.7	12.0

ATTACHMENT 1

TWIN CITY TEST RESULTS

1. OXIDE DENSITIES VS. SULFIDE DENSITIES:

ROCK TYPE	SULFIDE DENSITY	OXIDE DENSITY	OXIDE/SULF (%)
Trachyte por. waste	2.47	2.33	94.3
Trachyte por. ore	2.53	2.45	96.8
Breccia ore	2.44	2.39	98.0
		Mean	96.4
		s.d.	1.9

2. ORE DENSITIES VS. WASTE DENSITIES:

ROCK TYPE	ORE DENSITY	WASTE DENSITY	WASTE/ORE (%)
Trachyte por. & breccia sulfide	2.49	2.47	99.2
Trachyte por. & breccia oxide	2.42	2.33	96.3
		Mean	97.8
		s.d.	2.1

ATTACHMENT 2

SUMMARY OF GILT EDGE DENSITY MEASUREMENTS

AVERAGE DENSITY TRACHYTE PORPHYRY:	12.47 CUFT/TON
AVERAGE DENSITY DEADWOOD & PRECAMBRIAN:	11.13 CUFT/TON
AVERAGE DENSITY QUARTZ TRACHYTE PORPHYRY:	11.44 CUFT/TON

ROCKTYPE	SAMPLE	LOCATION	TOP (FT)	FEET	WEIGHT	CUFT/TON	WTxDENS
Trporph	V1	D88-65	232	2.5	78	12.97	1005
	V2	D88-66	153.6	2.3	71	12.56	896
	V3	D88-67	158.4	3.0	93	12.66	1177
	V4	D88-67	240	2.7	84	12.66	1060
	V5	D88-67	463.3	2.6	81	12.51	1008
	V6	D88-69	584.3	2.5	78	12.46	966
	V7	D88-69	737.2	2.5	78	12.41	962
	V8	D88-69	887.5	2.5	78	12.76	989
	V9	D88-70	160.4	2.1	65	13.02	848
	V10	D88-72	1032.3	3.6	112	12.51	1396
	C1	D88-65	211.0	3.0	93	12.13	1128
		D88-66	185.6	2.8	87	12.13	1053
		D88-67	305.8	3.4	105	12.13	1279
		D88-68	582.7	2.8	87	12.13	1053
		D88-69	733.4	2.9	90	12.13	1090
		D88-70	156.5	2.7	84	12.13	1015
		D89-72	1008.7	3.3	102	12.13	1241
	C6	Ox Pit			580	12.61	7314
AVERAGE	12.47			SUMS	2043.20		25478.90
Ddwd/Pc	C4	D88-71	42.0	2.8	87	11.12	965
		D88-71	56.5	2.5	78	11.12	862
		D88-71	90.0	2.3	71	11.12	793
		D88-71	109.5	2.1	65	11.12	724
		D88-71	161.2	2.7	84	11.12	931
		D88-71	180.0	2.8	87	11.12	965
		D88-71	183.5	2.8	87	11.12	965
		D88-71	100.4	3.1	96	11.12	1069
	C5	D88-68	668.2	2.6	81	11.16	899
		D88-68	672.9	2.3	71	11.16	796
		D88-68	680.7	2.6	81	11.16	899
		D88-68	685.0	2.0	62	11.16	692
		D88-68	157.4	2.8	87	11.16	969
AVERAGE	11.13			SUMS	1035		11529
Qtrpor	C7	D88-68	802.2	2.6	81	11.44	922
		D88-69	644.5	2.5	78	11.44	887
		D88-69	648.0	2.5	78	11.44	887
		D88-68	782.0	13.5	419	11.44	4788
AVERAGE	11.44			SUMS	654		7483

INTRODUCTION

This report covers the investigation of the recovery of gold from Brohm Mining's Gilt Edge Expansion Project. The testwork was requested by Mr. I. Callow of Bechtel Incorporated.

The main objectives of the test program were as follows:

1. Select and optimize the main recovery process and generate the process parameters.
2. Improve the recovery of gold from gravity concentrates and flotation concentrates.
3. Determine the suitability of SAG mill grinding and provide data for sizing the mills.
4. Determine the variability in grinding and leaching characteristics of the ore within the trachyte porphyry zone.
5. Determine the variability in grinding and leaching characteristics of other ore types (Composites No. 4, 5, 6 and 7).

LAKEFIELD RESEARCH

K. J. Smith

for R.S. Salter
General Manager

A.C.T. Bigg, P. Eng.
Senior Engineer

D.P. Evans
Project Metallurgist

SUMMARY

1. Feed Samples

Five different ore samples were used for the laboratory and pilot plant testwork. The ore was recovered from 2000 feet of 6 inch drill core from eight different holes drilled in Brohm's sulphide ore body. The five ore types studied were as follows:

Table No. 1: Sample Description

Composite Number	Ore Types	Quantity Received Kg (approximate)
C1	Trachyte Porphyry	280
C4	Cambrian Deadwood Hornfels	320
C5	Precambrian Schist	200
C6/C6-B	Trachyte Porphyry from Pit	260
C7	Quartz Trachyte Porphyry	322
V1-V10	Selected Trachyte Porphyry	385
DC	Drill Core	17200
OPS	Open Pit Sulphide	19500

The open pit sulphide represented the sulphide ore exposure in Brohm's present oxide pit and the DC composite represented underground ore from the same ore body. The DC composite was used on the test ore in the SAG mill/ball mill circuit. Table No. 2 summarizes the variation in the head grade, ball and rod mill work indices and the in-situ bulk densities of the various ore types.

Table No. 2 - Summary of Head Assay, Work Indices and In-situ Bulk Densities

Product	Assay			Specific Gravity (g/mL)	Work Indices		In-Situ Density (g/mL)
	Au, g/t	Ag, g/t	S, %		Ball Mill (metric)	Rod Mill (metric)	
V1	0.38	2.2	3.09	2.91	14.7	17.4	2.47
V2	0.85	8.0	6.80	2.81	13.1	14.4	2.55
V3	1.13	<2.0	1.84	2.65	16.9	18.2	2.53
V4	5.92	13.0	4.77	2.74	14.7	16.5	2.53
V5	0.57	3.0	4.55	2.71	17.1	17.0	2.56
V6	1.67	<2.0	1.30	2.61	17.8	20.2	2.57
V7	0.55	<2.0	0.03	2.62	19.6	15.3	2.58
V8	4.78	<2.0	2.09	2.66	16.9	18.6	2.51
V9	0.45	<2.0	2.26	2.65	19.7	23.2	2.46
V10	0.25	<2.0	1.11	2.63	19.7	22.0	2.56
C1	3.16	2.2	3.88	2.71	18.4	22.1	2.64
C4	0.99	<2.0	4.21	2.91	20.0	24.1	2.88
C5	1.00	<2.0	0.98	2.88	14.8	17.9	2.87
C6	0.22	<2.0	2.36	2.67	16.2	21.8	2.54
C6-B	2.32	5.5	3.07	2.64	16.9	17.9	2.28
C7	1.76	3.7	1.84	2.64	20.4	23.8	2.80
DC Comp	2.07	5.2	5.16	2.76	14.9	18.0	

Ag assay <2.0 g/t

2. Grinding Tests

2.1 General

Due to the limited quantity of drill core available initial grinding parameters were established using the open pit sulphide (OPS). Once these conditions were established the drill core composite (DC comp) was run. The DC comp was blended by Brohm to represent the trachyte porphyry (C1 composite).

As summarized in Table No. 3, the DC comp was prepared at Lakefield Research to give the same weight proportion of the individual size fractions as the open pit sulphide.

July 10, 1987

To: Contractors

From: D.E. Stewart

Subject: In Place Rock Density and Specific Gravity
Abrasion Index, Impact Work Index, Bond Work Index

The attached information represents results from Twin City testing of rock types from the Gilt Edge Site. Wet density is in lbs/cubic feet for In Place Density. Specific gravities were also analyzed. Each sample has 3 pieces to represent the different rock types. The following is a list of rock types that each sample represents.

Sample 1 = Trachyte Oxide Waste
Sample 2 = Trachyte Oxide Ore
Sample 3 = Trachyte Sulphide Waste
Sample 4 = Trachyte Sulphide Ore
Sample 5 = Trachyte Breccia Oxide Ore
Sample 6 = Trachyte Breccia Sulphide Ore
Sample 7 = Rhyolite Sulphide Waste
Sample 8 = Rhyolite Oxide Waste

A second report is attached of test work completed by Allis Chalmers. Test results include an Impact Work Index, Abrasion Index, and Bond Work Index for ore type materials.

D. E. Stewart

twin city testing corporation
2931 SAMCO ROAD
RAPID CITY SD 57702
PHONE 605 348 5850

REPORT OF: BULK DENSITIES OF CORE SAMPLES

PROJECT: GILT EDGE MINE

DATE: 5-8-87

REPORTED TO: Gilt Edge Inc.
P O Box 485
Deadwood, SD 57732

FURNISHED BY:

COPIES TO:

LABORATORY No. 6100 87-139

wax density
H2O displacement

SAMPLE NUMBER:		1			2			3	
	51	53	49	78 *	79	80.5	635	632	633
WET DENSITY:	146.1	148.1	141.9	138.8	158.1	161.8	153.3	157.2	151.4
SPECIFIC GRAVITY:	2.34	2.37	2.27	2.22	2.53	2.59	2.46	2.52	2.43

AVERAGES (3)

	1	2	3
Wet Density	145.4	152.9	154.0
Specific Gravity	2.33	2.45	2.47

SAMPLE NUMBER:		4			5			6	
	132	127	134 *	21+	24	25+	474	470	473
WET DENSITY:	155.7	159.7	182.2	148.9	149.3	149.5	153.4	150.4	153.5
SPECIFIC GRAVITY:	2.50	2.56	2.92	2.39	2.39	2.40	2.46	2.41	2.46

AVERAGES (3)

	4	5	6
Wet Density	157.9	149.2	152.4
Specific Gravity	2.53	2.39	2.44

* Samples were not used as an average due to large differences in unit weights.
The difference was due to voids and mineralogical composition.

twin city testing
corporation
2843 T SAMCO ROAD
RAPID CITY SD 57702
PHONE 605/348 5850

REPORT OF: BULK DENSITIES OF CORE SAMPLES

LABORATORY No. 6100 87-139

DATE: 5-8-87

PAGE: 2

SAMPLE NUMBER:		7			8	*
	269	267	270	244	238	237
WET DENSITY:	144.8	149.5	146.4	144.0	147.7	136.6
SPECIFIC GRAVITY:	2.32	2.40	2.35	2.31	2.37	2.19

AVERAGES (3)

Wet Density	146.9	146.0
Specific Gravity	2.36	2.34

REMARKS:

The above samples were submitted to personnel of TCT and received here on 5-3-87.

TWIN CITY TESTING CORPORATION

James A Bertsch

James A Bertsch, Mgr - Geotechnical Engineer EIT
Rapid City office

JAB/ew

FORM 4038-2
LITHO IN U.S.A.—A-C

ALLIS-CHALMERS
PROCESS RESEARCH AND TEST CENTER

TEST REPORT

Test No. 87-032 Charge No. 01-6102-52747 Date Reported 4/17/87

Submitted by (customer) Brohm Mining

Gild Edge Mine

Test Requested by M. T. Erickson Div. E & MS

References

SAMPLE AS RECEIVED

Weight 100 lbs (3 x 5 Gal. Pails) Date Rec'd. 4/7/87
40 lbs (1 x 5 Gal. Pail) 4/8/87

Description

TEST PROCEDURE

Type of Test
Impact Crushability Test
Pennsylvania Abrasion Test

Equipment Used
Bond Twin Pendulums Impact Crushing Tester
Pennsylvania Abrasion Tester

Test Results

Impact Work Index	=	7.9 (8.7 Metric)
Abrasion Index	=	0.1300

Samples to be discarded on July 31, 1987.

By E. J. [illegible] L. Dieter

ALLIS-CHALMERS
BOND TWIN PENDULUMS IMPACT CRUSHING TEST

MATERIAL ROCK
SUBMITTED BY BROHM MINING CO.
GILD EDGE MINE

TEST NO. 87-032 DATE 4-13-87

SPECIMEN NO.	RANK	THICKNESS MM	INCH	WEIGHT GRAMS	PRODUCT PIECES	ANGLE AT BREAKAGE	FT*LB PER INCH	WORK INDEX
1	8	75.	2.95	624.	4.	35.	5.0	5.0
2	5	62.	2.44	497.	2.	30.	4.5	4.5
3	14	68.	2.68	912.	4.	40.	7.2	7.1
4	22	65.	2.56	858.	3.	65.	18.5	18.4
5	24	65.	2.56	840.	3.	75.	23.7	23.6
6	23	67.	2.64	818.	10.	75.	23.0	22.9
7	13	61.	2.40	386.	3.	35.	6.2	6.1
8	10	70.	2.76	712.	3.	35.	5.4	5.3
9	15	66.	2.60	724.	4.	40.	7.4	7.3
10	3	70.	2.76	608.	3.	20.	1.8	1.8
11	20	58.	2.28	386.	4.	45.	10.5	10.4
12	1	60.	2.36	387.	3.	15.	1.2	1.2
13	17	79.	3.11	942.	2.	45.	7.7	7.7
14	18	57.	2.24	734.	2.	40.	8.5	8.5
15	4	63.	2.48	533.	3.	25.	3.1	3.1
16	6	62.	2.44	414.	2.	30.	4.5	4.5
17	19	65.	2.56	522.	2.	45.	9.4	9.3
18	2	58.	2.28	633.	2.	15.	1.2	1.2
19	12	63.	2.48	548.	3.	35.	6.0	5.9
20	16	66.	2.60	623.	3.	40.	7.4	7.3
21	11	66.	2.60	504.	2.	35.	5.7	5.7
22	9	55.	2.17	426.	2.	30.	5.1	5.0
23	21	73.	2.87	709.	3.	60.	14.3	14.2
24	7	62.	2.44	395.	2.	30.	4.5	4.5

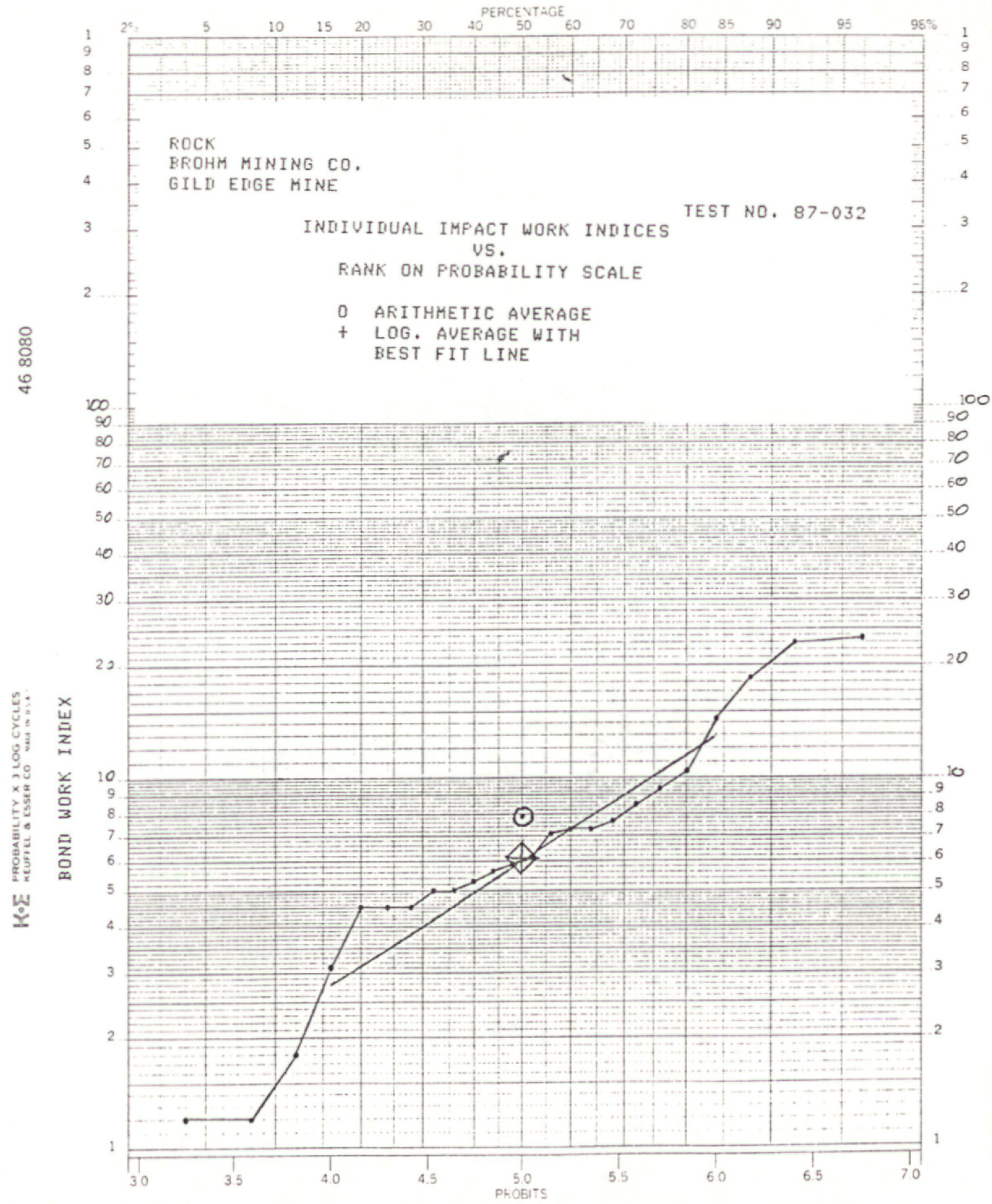
	INCH	WEIGHT GRAMS	PRODUCT PIECES	FT*LB PER INCH	WORK INDEX
AVERAGE	2.55	613.96	3.1	7.99	7.9
MAXIMUM	3.11	942.00	10.0	23.75	23.6
MINIMUM	2.17	386.00	2.0	1.18	1.2
STD.DEVIATION	0.22	173.00	1.6	5.99	5.9
95% CONF.INTRVL.	0.09	69.21	0.6	2.40	2.4
OMIT MAX AND MIN VALUES					
AVERAGE	2.54	609.41	2.8	7.58	7.5
STD.DEV.	0.18	159.30	0.7	5.06	5.0
95% CONF.INTRVL	0.08	66.56	0.3	2.12	2.1

SPECIFIC GRAVITY= 2.61

BOND WORK INDEX (W.I.)= 7.9 +/- 2.4
=2.59*(FT*LB/INCH)/SPGR +/- 95% CONFIDENCE INTERVAL
W.I.METRIC (W.I.M.) = 8.7 +/- 2.6 =1.1023*(W.I.)

WHEN RANKED AND PLOTTED AS LOG(W.I.) VS. PROBABILITY,
THE BEST FIT STRAIGHT LINE HAS A PROBABILITY OF
84.1% WITH W.I. LESS THAN OR EQUAL TO 13.0
50.0% WITH W.I. LESS THAN OR EQUAL TO 6.1
15.9% WITH W.I. LESS THAN OR EQUAL TO 2.8

Fig. 1



PERCENTAGE
ROCK
BROHM MINING CO.
GILD EDGE MINE
TEST NO. 87-032
INDIVIDUAL IMPACT WORK INDICES
VS.
RANK ON PROBABILITY SCALE
O ARITHMETIC AVERAGE
+ LOG. AVERAGE WITH
BEST FIT LINE
BOND WORK INDEX
PROBITS
46 8080
K&E PROBABILITY X 3 LOG CYCLES KEUFFEL & ESSER CO. MADE IN U.S.A.

Fig. 1a

SIEVE ANALYSIS ALLIS-CHALMERS

MATERIAL ROCK

SUBMITTED BY BROHM MINING CO.
GILDEN MINE

TEST NO.87-032 DATE 4/13/87

A= ABRASION TEST PRODUCT, ABRASION INDEX = 0.1800

B=

SIEVE SIZE		A		B		C		D	
EQUIV.	ASTM	PERCENTAGE		PERCENTAGE		PERCENTAGE		PERCENTAGE	
T.MESH	MU-M	ON	PASSING	ON	PASSING	ON	PASSING	ON	PASSING
.75	19000	0.00	100.00						
.53	13200	2.76	97.24						
.375	9500	37.84	59.39						
M=3	6700	13.43	45.96						
4	4750	7.30	38.66						
6	3350	4.10	34.56						
8	2360	3.58	30.98						
10	1700	2.84	28.14						
14	1180	2.13	26.00						
20	850	1.70	24.30						
28	600	1.53	22.77						
35	425	1.30	21.47						
48	300	1.67	19.81						
65	212	2.63	17.18						
100	150	3.27	13.91						
150	106	2.81	11.10						
200	75	2.15	8.95						
270	53	0.00	0.00						
325	45	0.00	0.00						
400	38	0.00	0.00						
500	26	0.00	0.00						
PAN	0	8.95	0.00						

	A	B	C	D
80 PCT. SIZE (LOG-LOG) =	11589.			
SLOPE,80% SIZE TO SMALLEST DATUM	0.435			
SPECIFIC GRAVITY	2.61			
ESTIMATED SP.GR. FOR 40% VOIDS	0.00			
VOIDS FRACTION	*******			
BULK WEIGHT (LBS/FT**3)	*******			

Fig. 2

```
SIEVE ANALYSIS                                          ALLIS-CHALMERS
MATERIAL        ROCK
SUBMITTED BY    BROHM MINING CO.
                GILDEN MINE
TEST NO.87-032                                     DATE 4/13/87

  A= ABRASION TEST PRODUCT, ABRASION INDEX = 0.1800
         100                   10    WEIGHT % PASSING  1              .2
MESH MU-M 198  6 5 4  3   2     198  6 5 4  3   2     198  6 5 4  3   2
.75 19000 A

.53 13200 *A                                                          *

.375 9500      A

M=3  6700         A

  4  4750           A

  6  3350            A

  8  2360             A

 10  1700              A

 14  1180              A

 20   850               A

 28   600                A

 35   425                A

 48   300                 A

 65   212                  A

100   150                    A

150   106                       A

200    75                         A

270    53
325    45
400    38

500    26 *                                                           *
MESH MU-M 198  6 5 4  3   2     198  6 5 4  3   2     198  6 5 4  3   2
1=A+B    2=A+C    3=A+D    4=B+C    5=B+D    6=C+D
7=A+B+C  8=A+B+D  9=A+C+D  0=B+C+D  +=A+B+C+D
```

Fig. 2a

DAWSON
METALLURGICAL
LABORATORIES, INC.

P.O. Box 7685
5217 Major Street
Murray, Utah 84107-0685
Phone: 801-262-0922

August 28, 1985

Mr. Richard T. Hall
Lacana Gold Incorporated
2005 Ironwood Parkway, Room 105
Coeur d' Alene, Idaho 83814

Subject: Specific Gravity Measurements for Your Samples R.R.#8, R.R.#26, and R.R.#41. Our Project No. P-1045 J.

Dear Mr. Hall:

The specific gravity for the three samples that were received August 27, 1985 were:

Sample Description	Specific Gravity
R.R. #8	2.58
R.R. #26	2.62
R.R. #41	2.58

These specific gravity measurements were made with 50 to 60 grams of sample in a LeChatelier specific gravity bottle filled with kerosine displacement fluid and maintained at a constant temperature.

We appreciate working with you. If you have any questions, please contact us.

Sincerely,
DAWSON METALLURGICAL LABORATORIES, INC.

W. Richard McDonald
W.Richard McDonald,
Consulting Metallurgist

WRM-cac

DAWSON
METALLURGICAL
LABORATORIES, INC.

P. O. Box 7685
5217 Major Street
Murray, Utah 84107
Phone: 801-262-0922

PROJECT NO. P-1045-J
DATE 8/28/85
BY MT

TEST NO. 1 NAME Lacana Mining

PRODUCT	Weight	SP.GR.	ASSAY					UNITS			DISTRIBUTION				
R.R. #8		2.58													
R.R. #26		2.62													
R.R. #41		2.58													

													GRINDING PRODUCT	
OPERATION														
TIME														
REAGENTS - LBS. PER TON														
												MESH	%	%
												+10		
												+14		
												+20		
												+28		
												+35		
												+48		
												+65		
												+100		
												+150		
MACHINE												+200		
R.P.M.												+325		
pH												-325		
% SOLIDS														
TEMPERATURE														

REMARKS: